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AUTHOR	Adkison, Stephen
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ABSTRACT

Focusing specifically on the theories offered by language development theorist L. S. Vygotsky and evolutionary theorist Terrence Deacon, this paper examines the ways in which theories of language in composition studies coincide and differ with the theories currently being researched in neurobiology and physical anthropology. This examination considers a broader and deeper view of language development than is possible from the perspective of any single discipline, a view which may eventually redefine the boundaries of language development theories in both composition and brain studies. For example, PET (Position Emission Topography) brain scans of language use suggest exactly the view of language use and meaning-making developed by psychologist Jerome Bruner. Similarly, Deacon's explanation of Baldwinian selection in the evolution of language and Vygotsky's concepts of language learning and creativity dovetail, and indeed offer compelling mutual support. Through an analysis of this type of correspondence between the different areas of research, this presentation offers an interdisciplinary argument in which theories of brain and language evolution give language and learning theories in composition studies a sound underpinning, while at the same time language and learning theories offer a complementary conceptual framework for neurobiological and language evolution studies. This inquiry into the nature of language--how it works, and why and how it evolved--has important implications for composition studies and approaches to both cognitive theory and how this pedagogy is developed. A discussion of these implications and how they can be linked to a wider context, that of the classroom and the teaching of writing and language, as well as language and learning in the disciplines is included. (Contains 12 references.) (Author/RS)

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by Stephen Adkison

Paper presented at the Annual Meeting of the Conference on College Composition and Communication (52nd, Denver, Colorado, March 14-17, 2001).

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Toward a Coevolution of Language Theories: Linking Composition with Brain and Language Studies

Stephen Adkison, Idaho State University

Abstract

Recent research by neurobiologists, coupled with new theories of language evolution in physical anthropology, suggests that behavioral flexibility (learning and creativity) plays an integral part in both language and cognitive development. This presentation links current theories of language development and pedagogy in composition studies with these recent developments in physical anthropology and neurobiological research. Historically, evolutionary explanations of language, from language acquisition device theories to popular views of Darwinian evolution, have been simplistic and have ignored how social behavior functions in the development of language and learning as well as the day-to-day use of language. New work in language evolution focusing on behavioral flexibility offers a way to link cognitive theories in both composition and neurobiology. Focusing specifically on the theories offered by language development theorist L.S. Vygotsky and evolutionary theorist Terrence Deacon, this presentation examines the ways in which theories of language in our discipline, composition studies, coincide and differ with the theories currently being researched in neurobiology and physical anthropology. This examination helps lead us to consider a broader and deeper view of language development than is possible from the perspective of any single discipline, a view which may eventually redefine the boundaries of language development theories in both composition and brain studies. For example, PET brain scans of language use suggest exactly the view of language use and meaning-making developed by psychologist Jerome Bruner. Similarly, Deacon's explanation of Baldwinian selection in the evolution of language and Vygotsky's concepts of language learning and creativity dovetail, and indeed offer compelling mutual support. Through an analysis of this type of correspondence between the different areas of research, this presentation offers an interdisciplinary argument in which theories of brain and language evolution give language and learning theories in composition studies a sound underpinning, while at the same time language and learning theories offer a complementary conceptual framework for neurobiological and language evolution studies. This inquiry into the nature of language — how it works, and why and how it evolved — has important implications for composition studies and our approach to both cognitive theory and how we develop our pedagogy. The presentation will close with a discussion of these implications and how we can link them to a wider context, that of the classroom and the teaching of writing and language, as well as language and learning in the disciplines.

What is Language?

How does Language work?

Why and how did Language evolve?

The answers to these questions seem to me to hold important implications not only for our understanding of language behavior but for the ways in which we construct our own knowledge as well, not just as humans but specifically as teachers.

Arriving at and understanding the answers to these questions may lead to a better understanding of language development in children, but ultimately the pursuit of these answers lead us to consider what we do in constructing knowledge. My quest for understanding language behavior led me to research in two, until recently, unrelated academic fields, cognitive psychology and neurobiology. In my attempts to reconcile the research being done in both areas with what I have observed of language behavior, I came to understandings in our field that mirror the discoveries these two fields have shared in recent years. In so doing, I came to understand a bit more about how I construct my knowledge and, perhaps, about how knowledge is constructed in general.

This process of situating ourselves in our world, of creating a context in which we view the world and bring some sense and order to it is perhaps the most fundamental of all human activities. Margaret Donaldson, in **Children's Minds**, also refers to this constant learning process.

> Another way to put this is to say that we are, by nature, questioners. We approach the world wondering about it, entertaining hypotheses which we are eager to check. And we direct our questions not just to other people but to ourselves, giving ourselves the job of finding the answers by direct exploration of the world. In this way we build up

> what is fashionable to call a *model* of the world—a kind of system of inner representations, the value of which is to help us to anticipate events and be ready to deal with them. (67)

Donaldson goes on to note that the expectations we generate in this manner are powerful and that our interpretation of words and the situations we link them to are constantly influenced by these expectations (67). If this is so, then this constant process of negotiation implies that humans use this process as a sort of innate means of dealing with themselves and others. As Donaldson notes,

> In order to handle the world with maximum competence it is necessary to become skilled in manipulating systems and in abstracting forms and patterns. This is a truth which, as a species, we have slowly come to know. (83)

We all apply particular patterns when we form abstractions, thus bringing order and sense to particular bits of our worlds. And we all do this on greater and lesser scales every time we perceive, interpret and analyze what is going on around us. We cannot help but see the world through the filter of our own experience and expectations.

Donaldson's views of social negotiation as an essential human process by which we construct meaning in our world are consistent with the work of L. S. Vygotsky. Vygotsky's studies of children and their language development led him to develop a view of language as an ever-changing dynamic process through which both the child's expectations as well as outside feedback affects the language meanings the child holds. In essence, Vygotsky notes,

> The relation of thought to word is not a thing but a process, a continual movement back and forth from thought to word and from word to thought. . . . Thought is not merely expressed in words; it comes into existence through them. Every thought tends to establish a relation between things. Every thought moves, grows, and develops, fulfills a function, solves a problem. (218)

Vygotsky's conclusions about the process of this constant negotiation led him to posit a theory of inner speech, a sort of constant dialogue that humans engage in by which they compare their memory to all that they experience and observe. This comparison enables humans to constantly refine their inner speech so that it has increasingly greater power to explain the world they see around them. But this exchange is not one-way; outside experiences and observations not only affect our beliefs and memories, but our own particular inner speeches affect how we perceive and experience the world. Mirroring Donaldson's comments, Vygotsky notes that inner speech "does not merely accompany the child's activity; it serves mental orientation, conscious understanding; it helps in overcoming difficulties" (228). According to Vygotsky inner speech allows humans to consciously direct their thought processes. This direction involves several mental functions including memory, conceptual thought, analysis, synthesis, and evaluation, and even imagination. Through our inner speech this process is unceasing and all of these mental functions are in constant collaboration. We tend, as Vygotsky puts it, to build and hang our meanings on a scaffold that this collaboration helps us construct.

If Vygotsky and Donaldson are right in believing that we make knowledge, that we learn, through constant social negotiation then how is it that this tendency arises in the human mind? Donaldson suggests that this proclivity is innate, a part of our being human. Referring to a series of experiments carried out by Hanus Papousek in which he concluded that infants were motivated primarily by a sense of mastery in manipulating a series of lights, Donaldson notes that "If he is right in this—and there is a considerable amount of other confirming evidence—then we may conclude that there exists a fundamental human urge to make sense of the world and bring it under control" (116). She

goes even further with this suggestion a few lines later when she states that,

> As soon as a species abandons reliance on instinctual patterns of behavior and begins to rely instead on building inner representations and making predictions then it becomes critical for survival to get the predictions right. Thus the realization of incongruity between our notion of the world and what it turns out to be like should naturally lead us to want to understand it better. (117)

Donaldson seems to suggest some type of sociobiological basis for a socially-constructed theory of learning? Is there any biological evidence for the theories that she and Vygotsky have developed through their observations? Though Noam Chomsky and others once posited a sort of black box that enables humans to acquire language, little solid research has really addressed how our brains function, biologically speaking, in processing language.

However in the late 1980s and early 1990s, new ways of interpreting data from positron emission tomography and functional magnetic resonance imaging suddenly gave neurobiologists a new tool for looking not just at the brain's anatomy but at the functions of the brain itself. Simply put, these two tools map images of blood flow within the brain during specific activities (Montgomery, 63). Using this technique, neurobiologists can actually map the brain topography and functions underlying language use. Neurobiologists can, for instance, see what parts of a person's brain are active when they are reading, writing, listening, speaking and hearing. The information resulting from these new techniques has brought a revolution to neurobiology that has begun uniting the once separate fields of cognitive psychology and neurobiology (Kandel & Hawkins, 79).

This research has led neurobiologists to hypothesize that the brain processes language by means of three interacting sets of structures. Antonio and Hanna Damasio explain these structures in the article *Brain and Language*, an

article published as part of a special edition of **Scientific American** in September of 1992.

> First, a large collection of neural systems in both the right and left cerebral hemispheres represents nonlanguage interactions between the body and its environment, as mediated by varied sensory and motor systems. The brain not only categorizes these nonlanguage representations, it also creates another level of representation for the results of its classification. In this way people organize objects, events and relationships. Successive layers of categories and symbolic representations form the basis for abstraction and metaphor.
>
> Second, a smaller number of neural systems, generally located in the left cerebral hemisphere, represent phonemes, phoneme combinations and syntactic rules for combining words. When stimulated from within the brain, these systems assemble word forms and generate sentences to be spoken or written. When stimulated externally by speech or text, they perform the initial processing of auditory or visual language signals.
>
> A third set of structures, also located largely in the left hemisphere, mediates between the first two. It can take a concept and stimulate the production of word forms, or it can receive words and cause the brain to evoke the corresponding concepts. (89)

Neurobiologists now see language in ways that they had never considered. Neurobiologists are beginning, much like Vygotsky and Donaldson, to perceive language as a process of constant activity and negotiation that engages all the functions of the brain to some extent or another at some time. As the Damasios note, when neuroscientists talk about language, they now "talk about the ability to use words and to combine them in sentences so that concepts in our minds can be transmitted to other people. We also consider the converse: how we apprehend words spoken by others and turn them into concepts in our own minds" (89).

These views do not seem so different from the terms in which Vygotsky

and Donaldson view language. The social negotiation that is central to both Vygotsky's and Donaldson's views are also inherent in the terms of which Damasio & Damasio speak. In fact Kandel and Hawkins, both neurobiologists, write that,

> Learning is the process by which we acquire new knowledge, and memory is the process by which we retain that knowledge over time. Most of what we know about the world and its civilizations we have learned. Thus learning and memory are central to our sense of individuality. Indeed, learning is a major vehicle for behavioral adaptation and a powerful force for social progress. (79)

In making this statement, Kandel and Hawkins align themselves unmistakably with Vygotsky and Donaldson. When they mention memory, they refer to a phenomenon that neurobiologists call "cognitive compression" which helps to "categorize the world and to reduce the complexity of conceptual structures to a manageable scale" (Damasio & Damasio, 89). Cognitive compression sounds much like Vygotsky's notion of inner speech, both by definition and by function. As the Damasios explain cognitive compression,

> The word "screwdriver," for example, stands for many representations of such an instrument, including visual descriptions of its operation and purpose, specific instances of its use, the feel of the tool or the hand movement that pertains to it. The cognitive economies of language—its facility for pulling together many concepts under one symbol—make it possible for people to establish ever more complex concepts and use them at levels that would otherwise be impossible. (89)

Cognitive compression, like inner speech, is the mental shorthand which makes it possible for one person to communicate with another through more social modes of communication. Even Donaldson's suggestion that socially-constructed learning has a sociobiological basis finds support from Damasio &

Damasio, who mention that

> Language seems to have appeared in evolution only after humans and species before them had become adept at generating and categorizing actions and at creating and categorizing mental representations of objects, events and relations. Similarly, infant's brains are busy representing and evoking concepts and generating myriad actions long before they utter their first well-selected word. (89)

Until recently these fundamental processes defied description in the mechanistic terms of neuroscience. In fact as Patricia Goldman-Rakic notes, for the greater part of this century neurobiologists often denied that such functions were accessible to scientific analysis or declared that they belonged strictly to the realm of psychology (111). However neuroscientists, aided by new techniques and the information they have gained with them have made great strides in understanding the relationships between cognitive processes and the organization of the brain. As a result even global mental activities such as thought can be meaningfully studied in the laboratory. The ultimate goal of neurobiologists, as Goldman-Rakic notes, "is extraordinarily ambitious. Eventually researchers such as myself hope to be able to analyze higher mental functions in terms of the coordinated activation of neurons in various structures of the brain. It should also be possible to identify the cells that mediate the activity of those structures" (111).

Since the elementary aspects of these learning mechanisms can now be studied on the cellular and even molecular level, the analysis of learning may provide insights into the molecular mechanisms underlying a mental process and is bridging the gap between cognitive psychology and neurobiology. The process of bridging this gap has resulted in the availability of information that may well be leading to a "unified" theory of language development, unified in the sense that the theories of cognitive psychologists like Vygotsky and

Donaldson mesh neatly with the theories of neurobiologists, with the result of greater explanatory power for both. As Damasio & Damasio note,

> Language exists both as an artifact in the external world—a collection of symbols in admissible combinations—and as the embodiment in the brain of those symbols and the principles that determine their combinations. . . . As neuroscientists come to understand the neural basis for the brain's representations of external objects, events and their relations, they will simultaneously gain insight into the brain's representation of language and into the mechanisms that connect the two. (90)

This research has been promising so far in its ability to shed light on theories of language development and vice versa. We are a long way yet from knowing exactly how the brain processes language or even how the brain and language evolved; however the best cognitive research suggests a socially-constructed basis for learning and language development, and biological research provides evidence that the brain can and does function in this manner. Work in both fields is currently producing rapid progress.

Inasfar as evolutionary theories of the brain and language are concerned, the early thinking of Noam Chomsky has largely influenced initial theories, most recently through the writings of Chomsky's student Stephen Pinker. In these theories language is seen as "built in prior to language experience, like firmware in a desktop computer. The structure of language is imposed on strings of words" (Deacon, 1998). This is a conception of language as an external reflection of an internal language of the brain.

These theories, however, fall short in that they posit a view of neurobiological evolution that is overly simplistic and not generally accepted by evolutionary biologists themselves. This miscue causes theorists like Pinker to place too much emphasis on the innate aspects of language, while largely ignoring the social aspects.

In late 1997 Terence Deacon, a neurobiologist and evolutionary anthropologist, published "The Symbolic Species," a book in which he articulates an argument for the most cogent theory yet of how language and the brain, in his words, "co-evolved." (See attached diagrams) As Thomas Kuhn notes in **The Structure of Scientific Revolutions**, arguments in any given field of science rarely spring up full-blown and afresh, nor are most arguments based on truly novel ideas in a given field. Rather, most arguments result from the accumulation of research that eventually throws some aspect of that field into doubt in such a way that the questions raised can not be ignored and must be addressed. Such is the case with Terence Deacon's argument in **The Symbolic Species**. Deacon himself notes early in his preface that scholars interested in the origins of language have been actively pursuing their problems since the late 19th century (14), shortly after Darwin published his landmark **Origin of the Species**, which detailed his theory of evolution. In fact, the interest in this area was so great that the Société de Linguistique de Paris passed a resolution banning all papers on the origins of language. While Deacon notes that this resolution was meant to stem the flow of purely speculative papers and emphasize the society's concern with supporting research based on an empirical foundation, it did neither, and inquiry into the nature of language origins from a range of approaches has flourished since.

Unfortunately, Deacon notes, many of these approaches are based upon unquestioned

> assumptions about the nature of language and the differences between nonhuman and human minds [which] are implicit in almost every philosophical and scientific theory concerned with cognition, knowledge, or human social behavior. (14)

These unquestioned assumptions have often obscured the nature of the problems presented by how language originated, clouding both scholarly research as well as popular perceptions of language. Since, as Deacon briefly implies in the above passage, the search for the origins of language involves questions of cognition, knowledge, and human social behavior, any clouding or confusing of the issues is sure to, and often has, muddied the waters of this inquiry considerably. No matter what else it may be, the search for the origins of language is incredibly complex and presents an equally complex set of questions that must be addressed. The search is, Deacon notes, a "truly multidisciplinary problem that defies analysis from any one perspective alone"(14).

A look at Deacon's sources and at the sources of those he cites bears out this statement. Deacon and other physical anthropologists studying brain and language cite research which focuses primarily on one of three areas. These areas are

1) language studies concerning the nature of language and human cognition, which rise from physical anthropology (including primatology), cognitive psychology, linguistics, and philosophy.

2) brain studies concerning the identification and description of what is "unusual about human brain structure that corresponds with the unique problems posed by language" (13), which rise from physical anthropology, neurobiology, and anatomical studies.

3) evolutionary studies concerning the nature of evolutionary processes—evolution, natural and sexual selections, and related processes such as Baldwinian selection—as applicable to human physical and behavioral evolution, which rise from evolutionary anthropology, and evolutionary biology.

Interestingly, Deacon's argument attempts a synthesis which has never been addressed on such a large scale before in his own forum of physical anthropologists focused on the origins of brain and language. In fact, the only counterpart Deacon's argument has in any forum concerned with the origins of

language and the brain is Noam Chomsky's original theory of UniversalGrammar, situated as it is in the field of linguistics. In this respect, Chomsky's theory and subsequent work by other linguists provides an essential touchstone for Deacon's argument even as Deacon's work seeks to undermine the authority that Universal Grammar theory wields in the search for the origins of language and the brain.

Like Chomsky's theory in the field of linguistics, Deacon's overall argument is attractive in his home forum and seems to be effective because it accounts for data generated by research in a wide range of fields. Furthermore, Deacon's argument is appealing in his community precisely because it explains how the data from so many associated but still distinct fields of inquiry are related and how they might mesh to form a coherent whole. (In this endeavor he may be even more successful than Chomsky was in his earlier UG theorizing.)

Deacon's argument is inarguably admirable in scope and intention, relative both to his home forum and the larger forum of brain and language studies, and he has clearly accomplished the construction of a bold new perspective on the origins of human language. However, because rhetorical analysis of his argument suggests that the state of knowledge in the forum is incomplete at this point, his argument ultimately functions rhetorically as a beginning for his community of scholars, rather than as a comprehensive statement of their guiding theory.

Deacon's central claim that symbolic thinking triggered a co-evolutionary exchange between languages and brains over the course of hominid evolution such that many of the physical traits that distinguish human brains were caused by language behaviors shared down the generations suggests at least two

directions for further inquiry that Deacon directly addresses in his book. These two areas are focused, respectively, on the structural adaptations of language to human cognitive constraints, and on symbolic abilities and the ethical and social dimensions of human behavior.

Based on inquiry in these areas, Deacon posits two corollary claims rising from his central claim. In his discussion he constructs these claims as follows:

1) *The grammars of the world's languages are remarkably similar and are easily learned, despite their complexity, by young children, not because of innate grammatical knowledge but because languages themselves have evolved structural adaptations to human cognitive constraints.*

2) *Symbolic thought abilities allow humans access to others' thoughts and emotions, thus making possible the consideration of the ethical dimensions of social behavior.*

The first of these two corollary claims, that language acquisition in children is based on language itself having evolved structural adaptations to human cognitive constraints, is a considerably complex claim that rises directly from Deacon's third primary warrant and his central claim. Relying on evolution as a metaphor for how human language behaviors have changed over time in response to cognitive constraints set by the development of brain structures which enable symbolic thinking and process language, Deacon attempts to extend his argument that language evolution did not involve a language organ or instinct to refute a further aspect of Universal Grammar, namely language acquisition theory. In a most direct statement of this claim, Deacon also reveals his intention behind the claim. Deacon states that he believes that

> recognizing the capacity of languages to evolve and adapt with respect to human hosts is crucial to understanding another

> long-standing mystery about language that theories of innate knowledge were developed to explain: the source of language universals. Grammatical universals exist, but I want to suggest that their existence does not imply that they are prefigured in the brain like frozen evolutionary accidents. In fact, I suspect that universal rules or implicit axioms of grammar aren't really stored or located anywhere, and in an important sense, they are not *determined* at all. Instead, I want to suggest the radical possibility that they have emerged spontaneously and independently in each evolving language, in response to universal biases in the selection processes affecting language transmission. They are *convergent* features of language evolution in the same way that the dorsal fins of sharks, ichthyosaurs, and dolphins are independent convergent adaptations of aquatic species. Like their biological counterparts, these structural commonalities present in all languages have each arisen in response to the constraints imposed by a common adaptive context. (115-116)

Data that Deacon offers in support of this claim includes research into the evolution of color terms in different languages and different societies, which, according to Deacon, illustrates convergent word reference (116). Deacon is concerned in this line of reasoning with avoiding the fallacy of collapsing an irreducible "social evolutionary process into a static formal structure"(121) as he argues that Universal Grammar theory does. This fallacy leads Universal Grammar to ignore

> the effect of forces that could modify word formation and syntax over time, and of factors promoting converging or parallel trends, it also ignores the forces that stabilize language structure and are thus responsible for maintaining concordant use among contemporary individuals. (121)

Though Deacon's attempt to seek what E.O. Wilson refers to as theoretical consilience (see Chapter 1) is understandable in light of the overall argument he constructs in his book, this corollary claim drives an argument that fails rhetorically before it even gets started. This failure is due chiefly to the fact that

Deacon's claim is so vague and ambiguous that it is hard to draw a firm distinction between Universal Grammar as understood by linguists and described by Deacon and the "convergent" language universals that Deacon proposes. In addition no warrants for this corollary claim exist in Deacon's argument; the warrant that Deacon implies for this claim is actually a restatement of the claim itself, forcing his argument inescapably into the trap of circular logic.

In contrast to the circular logic of the first corollary claim, Deacon's second corollary claim is a more linear and logical outgrowth of his central claim, though it too is absent some of the elements necessary for it to function fully as an argument. In this second claim, Deacon argues that symbolic thought abilities allow humans access to others' thoughts and emotions, thus making possible the consideration of the ethical dimensions of social behavior. By way of establishing this claim Deacon first notes that

> Human social institutions, etiquette, and morality are predicated on the assumption that we *are* capable of such thinking about other minds. Even if this is a very fallible exercise, we expect people to engage in such activity under a variety of circumstances and are rightfully indignant or angered when they don't. (425)

Deacon goes on to note that without the ability to engage in symbolic reference, other species could not act according to a theory of others' minds, not to mention sharing representations of the experiences of others (428). It is exactly this sharing of common intentions, interests, and emotions that is the most effective means humans have for coordinating behavior, according to Deacon,

and the ability to imagine and anticipate another's mental and emotional responses is a powerful tool for social manipulation (428).

If Deacon is correct about the socio-sexual dilemma that helped drive the development of symbolic communication in the first place, "then the ability mentally to represent other minds is one of the primary functions of symbolization"(428).

That this corollary claim grows from Deacon's central claim is evident in that Deacon's first and second primary warrants concerning symbolic behavior also operate to connect the corollary claim to the data that Deacon offers to support it. Unfortunately the data that the warrants connect to this claim is ethereal at best, its existence suggested by Deacon rather than actually sketched out. Perhaps research in ethics or cognitive psychology or ethics could offer support for this corollary claim, but Deacon does not really pursue the claim in any serious sense, mirroring his larger argument's functional weakness in this area.

This particular area of cognitive psychology also returns this discussion to the theoretical perspective—shared by the Deacon as well as the other authors examined above— that suggests that human language development's most basic process concerns the use of inquiry, specifically, symbolizing behaviors as a tool to constantly create meaning and check language consistency in a fundamentally social world. Suzanne Langer, a mid-20th century philosopher whose book **Philosophy in a New Key** has been influential in rhetoric and composition studies, presaged much of this theoretical perspective when she stated her belief that language development is the result of "the symbolic transformation of experiences" (44). Humans are, as Langer puts it, "proliferators of symbols" and

> In language we have the free, accomplished use of symbolism, the record of articulate conceptual thinking; without language there seems to be nothing like explicit thought whatever. (103)

It is exactly this symbolic transformation of experience, Langer notes, that makes possible elaborate social communications, which in turn enriches our symbolic experience (44). I think that Terence Deacon would heartily concur.

In the end, Deacon's argument is important to rhetoric and composition for precisely the same reasons that the work of Britton, Bruner, Donaldson, Gusdorf, Vygotsky and Langer is, that is the focus on the social and symbolic nature of language in human learning and development. Deacon's argument specifically offers a dimension of time and biological development over the course of human evolution to questions of the nature of language. His focus on the symbolic nature of human behavior in the course of the evolution of language links learning theory and pedagogy in rhetoric and composition studies to brain and language studies in his field as well as to similar studies in related fields.

In closing, I offer a comment from E.O. Wilson which underscores the importance of interdisciplinary collaboration:

> Most of the issues that vex humanity daily —ethnic conflict, arms escalation, overpopulation, abortion, environment, endemic poverty, to cite several most persistently before us — cannot be solved without integrating knowledge from the natural sciences with that of the social sciences and humanities. Only fluency across the boundaries will provide a clear view of the world as it really is, ... A balanced perspective cannot be acquired by studying disciplines in pieces but through pursuit of the consilience among them. (13-14)

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Warrant #1

Symbolic thought and communication evolved as the means with which our hominid ancestors overcame the evolutionary difficulties of combining long-term sexual exclusivity through pair bonding, with cooperative group foraging.

Warrant #2

Language behavior reflects a symbolic thought process.

Warrant #3

The evolution of language did not involve a language organ or instinct, and did not result simply from a larger, more complex brain.

Symbolic thinking triggered a co-evolutionary exchange between languages and brains over the course of hominid evolution such that many of the physical traits that distinguish human brains were caused by language behaviors shared down the generations.

Deacon's Central Claim

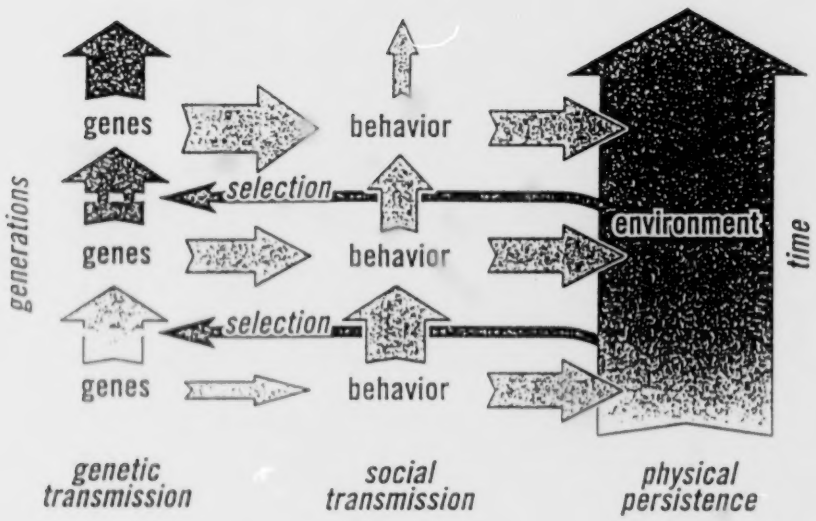

Figure 11.1 *Schematic diagram of processes underlying Baldwinian selection. Arrows pointing vertically depict three simultaneous transmission processes: genetic inheritance* (left), *social transmission by learning* (middle), *and persistence of physical changes in the environment produced by behavioral changes* (right). *Arrows pointing right indicate influences of genes on behavior and behaviors on the environment. Arrows pointing to the left indicate the effects of changed selection pressures on genes. The arrows for social transmission get thinner in each generation to indicate the reduced role of learning as a result of an increasing genetic influence to the behavior (indicated by arrows getting thicker from genes to behavior).*

from: Deacon, Terrence W. **The Symbolic Species: The Co-Evolution of Language and the Brain**. W.W. Norton: New York. 1997.

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